Patriot Vigilance Project—Training and Leader Development for the Future Force

By Dr. John K. Hawley

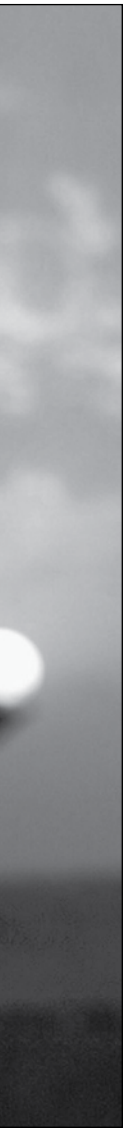
During the major combat operations phase of Operation Iraqi Freedom (OIF) in March and April 2003, US Army Patriot air defense missile units were involved in two fratricides incidents. In the first, a British Tornado was misclassified as an anti-radiation missile and subsequently engaged and destroyed. The second fratricide involved a Navy F/A-18 Hornet that was misclassified as a tactical ballistic missile, also engaged and destroyed. Three "friendly" flight crew members lost their lives in these incidents. OIF involved a total of 11 Patriot engagements by US units. Of these, nine resulted in successful missile engagements; the other two were fratricides.

This article discusses some of the major factors that contributed to fratricides during OIF Patriot engagements as well as effective techniques for their mitigation. It also addresses how holistic training mitigations can be used to combat the piecemeal training practices of the past effectively, while having a positive impact on training and leader development for the future force.

In 2004, a team from the Army Research Laboratory (ARL) began looking into Patriot system performance at the invitation of the then Fort Bliss, Texas, Commander and Chief of Air Defense Artillery (ADA), Major General (MG) Michael A. Vane. MG Vane was interested in operator vigilance and situation awareness as they relate to the performance of automated air defense battle command systems. Situation awareness, in present usage, is defined as the perception of elements in the environment, the comprehension of their meanings and the projection of their statuses in the near future.[1]

MG Vane was concerned particularly by what he termed a "lack of vigilance" on the part of Patriot operators along with an apparent "lack of cognizance" of what was being presented to them on situation displays with an ensuing "unwarranted trust in automation." The ARL project team spent most of the summer and fall of 2004 reviewing the OIF fratricide incidents and preparing an initial assessment report that was delivered to MG Vane later that year.

Our assessment was not to be just another exercise in "Monday-morning quarterbacking." Instead, the focus was to look into the deeper story behind the events leading to the OIF fratricides from a human-performance perspective and to identify actionable solutions. MG Vane's reference to lack of vigilance on the part of Patriot operators led to our work being referred to as the Patriot Vigilance Project. Results from ARL's initial assessment of the OIF Patriot fratricides were discussed in additional detail in an earlier article that appeared in both *Air Defense Artillery* and *Field Artillery* (FA) Bulletins.[2]



An Air Defense Soldier stands vigilant near a Patriot System. (Photo courtesy of Office of the Chief of Staff, Air Defense Artillery, Fort Bliss, Texas)

ARL's report to MG Vane recommended two primary actionable items to address the human dimension problems identified during the fratricide incident assessment. The first is to reexamine air defense battle command automation concepts to emphasize effective operator control—look into ways to mitigate situation awareness problems resulting from undisciplined automation of Patriot control functions.

The second actionable item is to develop more effective battle command teams. Reexamine the level of *expertise* required to employ systems, such as Patriot, on the modern battlefield. Although both of these topics are important, the discussion that follows focuses on the second issue, particularly as it relates to training and leader development for the future force.

Observing Patriot Unit Training. In late summer 2005, the ARL project team briefed MG Vane's successor, MG Robert P. Lennox, on the status and results of the Patriot Vigilance Project and follow-on work. Following that meeting, MG Lennox requested that ARL continue the project and work with the ADA community to implement selected actions. A major aspect of follow-on implementation was to serve as the Manpower and Personnel Integration (MANPRINT) evaluator during an operational test of a major software upgrade for the Patriot system. (MANPRINT is the Army's human-system integration initiative.) This upgrade was developed to address several of the Patriot system's deficiencies that were considered to have contributed to the unacceptable fratricide rate during OIF.

During the unit training period, from the fall of 2005 through the summer of 2006, we evaluated the unit's preparation for the upcoming test. Our observations regarding the training progress for the test unit sounded an alarm. Training was not progressing satisfactorily.

Training *events* were being completed, but individual- and crew-performance objectives were not being met. Many of the training issues identified during our follow-up to the initial fratricide inquiry were resurfacing because they had not been addressed adequately by training events in the test unit.

After reviewing these pretest training assessment results, we concluded that the real issue resulted from a failure to develop necessary levels of operator *expertise*, as opposed to aggregated individual task proficiencies. In many complex, knowledge-intensive jobs, the whole defined as competent job performance is more than the simple sum of competent individual task performances.[3]

Developing Expertise. What is expertise, and how is it different from aggregated individual task proficiency? In present usage, the term expertise refers to a capability for *consistently superior performance* on a specified set of representative tasks for a domain.[4] Expertise is a function of operator knowledge, skill, aptitudes and job-relevant experience. It also has been demonstrated that concentrating on the performance of individual tasks versus whole-job proficiency during training will not always result in the development of necessary levels of expertise as defined above.[5]

… to play a meaningful role in ensuring crew and unit readiness to perform, the new generation of leaders must know "what right looks like." Knowing what right looks like will require an increased emphasis on broad-based system and tactical expertise—not just superficial familiarity—during professional development.

Given the centrality of user expertise in the emerging warfighting environment, an obvious follow-on question is, "How is such expertise developed?" Three training features generally are considered necessary for the development of expertise: 1) extensive deliberate practice (defined as focused, job-relevant practice) with expert feedback; 2) scenarios characterized by increasing variability and novelty that challenge routine skills; and 3) a focus on developing sense-making skills that facilitate an operator's ability to recognize when to shift from automatic processing ("rote drills") to critical thinking and problem solving.[6]

Adaptive expertise will develop as a natural consequence of the long-term application of this progressive instructional strategy. However, all practice is not equal. Developing expertise requires a hands-on learning environment and many hours of practice under the supervision of a coach or mentor. Such feedback-intensive training is referred to as deliberate practice.

How many hours are necessary? D.A. Norman asserts in his book, *Things that Make Us Smart*, that for any complex activity, a minimum of 5,000 hours of deliberate practice—two years of full-time effort—is required to turn a beginner into an entry-level expert.[7] Expert, in this context, refers to a user who has developed the capability necessary to perform appropriately in a high-skill, knowledge-intensive job setting. Other research on the development of what are termed high-performance skills also supports this two-year rule.[8]

ADA Efforts to Implement These Concepts. Based on a convergence of results similar to those cited above, the ADA School at Fort Bliss concurred that a reexamination of air defense training strategies and practices was required. In addition to general agreement that a change in training rigor and instructional methods was necessary, the School identified an additional training capability gap. This gap concerned the simulation capability available to field ADA units.

The School concluded that units might benefit from a capability to train fire control crews that supplemented their embedded training capability and better supported performance-oriented instructional methods focused on deliberate practice. The School identified an existing device, the Reconfigurable Tactical Operations Simulator (RTOS), as potentially fulfilling the need for a simulation capability to supplement units' integral embedded training capability. The RTOS is a part-task Patriot simulator and has been used since the late 1970s to support air defense exercises as well as experimentation and analysis. However, it had not been used explicitly as a training device.

To begin exploring these issues, the ADA School organized what was termed the RTOS Operational Demonstration (OpDemo). The OpDemo was structured as a joint project involving the ADA School and an operational Patriot unit (5th Battalion, 52nd ADA). Its objectives were to demonstrate and evaluate modified instructional methods for use in unit training and assess the potential utility of an RTOS-like device to supplement unit training assets.

Results from the OpDemo indicate

that: 1) the RTOS (as an exemplar for a part-task, less-than-full fidelity training device) has the potential utility to support ADA unit training; 2) the training method focusing on deliberate practice was effective for the trial modules used; and 3) the overall training package was received well by participants.

Beyond these specific conclusions, the results indicate that the ADA School had a "green light" to pursue further development of an RTOS-like training device and modified instructional methods. Demonstration results also helped forge a general consensus among ADA decision makers and opinion leaders that the exercise was a success.

This development was important to maintaining the momentum for training reform initiatives because it helped offset the considerable resistance to less-than-full-fidelity training devices and changes in training methods that existed in some segments within the ADA community. As an added benefit, the training set-up used during the demonstration—the part-task device coupled with modified instructional methods—represented a partial prototype for a solution to the training deficiencies that contributed to the Patriot fratricides and that showed up again during the run-up to the operational test.[9]

…Our Soldiers and leaders … must be empowered with the ability … to use these systems as leadership enablers, not leadership substitutes. … If a bad decision is made, the excuse cannot be, "The network [or automated battle command system] made me do it." **LTC Samuel R. White Jr.**

Results from the Patriot Vigilance Project and RTOS OpDemo coupled with other internal developments contributed to the ADA School's current concept for a Reconfigurable Table-Top Trainer and other performance-impacting changes. These latter developments include upgraded training programs and supporting systems, modified curriculum and courses, changes in organization (such as using highly-experienced warrant officers as part of the battle command team in the Patriot Engagement Control Station and Information and Coordination Central), and professionalization of selected career tracks within the Branch (such as the ADA fire control officer). All of these on-going initiatives are focused on developing "the level of expertise required to operate such lethal systems on the modern battlefield."[10]

Expertise and Leader Development. The previous discussion focuses primarily on the training necessary to develop effective battle command teams. A variety of research indicates that effective crew and team leadership is a key factor in melding individual technical experts into high-performing teams.[11] However, the Army has not thought of battle command team development as part of the traditional *leader* development process.

In view of the results cited above, should that traditional position regarding leader development be reconsidered? Do the ideas concerning the importance of expertise and how it is developed discussed in the previous sections also apply to the more general topic of leader development?

Perhaps the most concise and elegant answer to this question was provided by Lieutenant Colonel Samuel R. White Jr. (FA) in his response to my initial article on the human dimension lessons of the OIF Patriot fratricides (see the January-February 2006 edition of *Field Artillery*). The crux of White's position is summarized as follows.

"…we have to stop thinking of AFATDS [advanced FA tactical data system] and other ABCS [Army battle command system] pieces as something run by an 'operator.' AFATDS is a command and control system and should be controlled by a leader who uses it to assess the situation, make decisions and direct actions. Yet in the past, we routinely put a very junior operator on the system who could set the machine up and run it well but couldn't leverage the C^2 [command and control] decision support capacities of the system….

"…Our Soldiers and leaders … must be empowered with the ability … to use these systems as leadership enablers, not leadership substitutes. … If a bad decision is made, the excuse cannot be, 'The network [or automated battle command system] made me do it.'"[12]

Based on results from ARL's four-year Patriot Vigilance Project, the ARL project team agrees with White's position that battle command systems cannot continue to be viewed as "something run by an operator." These systems are employed most effectively as leadership enablers, and leaders must be trained to use them as such.

The ADA Branch is addressing this issue with its decision to put warrant officers back into the Patriot vans. Due to their extensive training and long experience in a unit context, ADA warrant officers typically acquire the expertise necessary to function effectively as part of the ADA battle command team.

All of this is well and good, but what about commissioned officers? Do these ideas apply to their development as well? An often-repeated mantra from the business world is that "Management is not content-free." Is it possible to command a technology-centric military organization effectively without a thorough understanding of how that organization carries out its basic mission?

The questions raised above are not particularly new. For example, at the turn of the last century, the so-called "Fisher Revolution" brought about by the introduction of *HMS Dreadnought* into the Royal Navy necessitated a parallel and equally radical reform of long-standing training and personnel institutions, which involved both officer and enlisted personnel.[13] It simply was not possible to employ the technology packaged in the *Dreadnought* effectively without significantly better-trained crews and leaders than sufficed in the days of sail and cannon broadsides.

Later, during their development and application of the combined arms doctrine now known as blitzkrieg, the German Army emphasized upgraded officer technical training and experience, taking the position that "only a well-educated [officer] could appreciate the intricacies that chemistry, aeronautics and mechanical engineering had presented to the battlefield."[14] In an era of even higher technology and network-enabled warfare, effective human-system integration combined with leadership skill development becomes even more critical to mission success.

The previous discussion should not be interpreted to imply that the Army should abandon or deemphasize traditional leader development activities in favor of technology- and system-oriented training and development for officers and other senior leaders. In his letter to the editor cited earlier, White concluded by commenting on the differences between the French and German orientations toward artillery operations in the opening stages of World War II. He cites work by F.O. Miksche, observing that German artillery

A Patriot Advanced Capabilities (PAC)-3 launches during testing at White Sands Missile Range in New Mexico. Patriot is a high- to medium-altitude air defense system designed to intercept tactical ballistic missiles (TBMs) and "air-breathing" threats. (Photo courtesy of Lockheed Martin)

officers emphasized the needs of their supported organizations, while French gunnery officers were more focused on the technical than the tactical support aspects of fires planning.[15]

The lessons of White's historical caution are clear—competence in both the art and science of battle command is essential to success on the modern battlefield. The ARL project team supports the idea that traditional aspects of leader development training should be augmented along the lines suggested by White—the ability to employ battle command systems as leadership enablers. Empirical results from the Patriot Vigilance Project strongly support this position. Achieving the ends implied in our use of the terms "art" and "science" is the crux of the emerging leader development challenge.

What Has to Happen? One of the most important observations coming out of the Patriot Vigilance Project is the significant challenge involved in maintaining crew and unit readiness for a high-technology, knowledge-intensive system like Patriot. This challenge is aggravated by the turbulent contemporary operating environment—frequent deployments, the impact of the Army Force Generation process and the like. Leaders at all levels are the key to meeting this challenge.

However, to play a meaningful role in ensuring crew and unit readiness to perform, the new generation of leaders must know "what right looks like." Knowing what right looks like will require an increased emphasis on broad-based system and tactical expertise—not just superficial familiarity—during professional development.

In a technology-dominated organization, leader development is about more than troop-leading skills. The ADA Branch already has started down this path with its definition of alternative career tracks for officers. However, one should not underestimate the difficulty of melding such concepts with the Army's traditional view of a leader's ultimate role—that of commander.

At the same time, the Army's formal institutions must recognize and support, rather than impede, the development of essential leader expertise. We already have noted that the current one-size-fits-all approach to officer and NCO promotion and retention must be modified to support the goal of raising leader expertise. Jobs other than command are essential to the organization's success, and these jobs often involve intensive training and development activities not particularly focused on the command track.

Similarly, the Army's personnel system will need to be reworked. Reformed training and leader development practices overlaid on current personnel assignment patterns might not produce desired results. The risks associated with failure to change are clear—the performance promise of the emerging generation of technology-intensive systems might not be met without significant changes in training, leader development and personnel management practices. The Defense Science Board already has cautioned, for example, that there exists an increasing risk that training failure might negate hardware promise.[16]

Dr. John K. Hawley is Chief of the Army Research Laboratory Human Research and Engineering Field Element at Fort Bliss, Texas. He recently served as Project Lead on the Patriot Vigilance Project, an Army effort to examine human performance contributors to Patriot-involved fratricides during Operation Iraqi Freedom. He currently works with the Air Defense Artillery (ADA) to implement and evaluate selected recommendations involving human-systems integration practices, test and evaluation methods, personnel assignment practices and operator and crew training. He was commissioned as an officer in the Field Artillery in 1968, and, later that year when the branches split, was assigned to ADA, serving as an ADA officer for two years. He holds a Ph.D in psychology from the University of North Carolina at Chapel Hill and is a member of The Honorable Order of Saint Barbara and is an honorary Patriot "Top Gun."

Endnotes:

1. M.R. Endsley, B. Bolte, and D.G. Jones, *Designing for Situation Awareness: An Approach to User-Centered Design* (New York: Taylor & Francis), 2003.
2. J.K. Hawley, "Patriot Fratricides: The Human Dimension Lessons of Operation Iraqi Freedom [OIF]" *Field Artillery,* (January-February, 2006), 18-19; *Air Defense Artillery* (January-March 2006), 26-27.
3. J.K. Hawley, A.L Mares, and C.A Giammanco, *Training for Effective Human Supervisory Control of Air and Missile Defense Systems* (Adelphi, MD: US Army Research Laboratory), 2006.
4. K.A. Ericsson, and N. Charness, "Expert Performance: Its Structure and Acquisition," *American Psychologist,* 49 (Number 8, 1994), 725-747.
5. W. Schneider, "Training High-Performance Skills: Fallacies and Guidelines," *Human Factors,* 27 (Number 3, 1985), 285-300.
6. S.W.J. Kozlowski, "Training and Developing Adaptive Teams: Theory, Principles, and Research" in J. Cannon-Bowers and E. Salas (Editors) *Making Decisions under Stress: Implications for Individual and Team Training* (Washington, DC: American Psychological Association), 1998.
7. D.A. Norman, *Things that Make Us Smart* (Cambridge, MA: Perseus Books), 1993.
8. Schneider, *Training High-Performance Skills.*
9. For a more detailed a description, see J.K Hawley, A.L Mares, J.I. Fallin, and C. Wallet, *Reconfigurable Tactical Operations Simulator (RTOS) Operational Demonstration in 5-52 Air Defense Artillery* [5th Battalion, 52nd ADA] (Adelphi, MD: US Army Research Laboratory), 2007.
10. Paraphrase of a comment from the Army Board of Inquiry investigation of the OIF Patriot fratricides.
11. Kozlowski, *Training and Developing Adaptive Teams.*
12. Samuel R. White, "Responses to Patriot Fratricides—The Human Dimension Lessons of Operation Iraqi Freedom: Automated C^2 Has Implications for the FCS Force," *Field Artillery* (January-February, 2006), 2-3.
13. H.H. Herwig, "The Battlefleet Revolution: 1885-1914," in M. Knox & W. Murray (Editors), *The Dynamics of Military Revolution, 1300-2050* (New York: Cambridge University Press), 2001.
14. J.S. Corum, *The Roots of Blitzkrieg: Hans von Seeckt and German Military Reform* (Lawrence, KS: University Press of Kansas), 1992.
15. F.O. Miksche, *Attack: A Study of Blitzkrieg Tactics,* (New York: Random House), 1942.
16. Defense Science Board, *Training Superiority and Training Surprise.* (Final Report of the DSB Task Force on Training Superiority and Training Surprise) (Washington, DC: Office of the Undersecretary of Defense for Acquisition, Technology and Logistics), 2001.